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Original Article

RESPONSE OF GREENGRAM [*VIGNA RADIATA* (L.)]TO LEVELS OF VERMICOMPOST AND ZINCUNDER LOAMY SAND SOIL

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ABSTRACT

A field experiment was conducted to evaluate the effect of different vermicompost and zinc levels on nutrient content in plant and soil as well as yield potential of greengram in loamy sand soil at College Farm, S. K. N. College of Agriculture, S. K. N. Agriculture University, Jobner, Rajasthan during kharif season of2016. The experiment was laid out in a randomized block design with three replications consisting of 16 treatments, namely, vermicompost levels (control, VC @ 2.5 t ha^{-1}, VC @ 5.0 t ha^{-1} and VC @ 7.5 t ha^{-1}) and zinc levels (control, Zn @ 2 kg ha^{-1}, Zn @ 4 kg ha^{-1} and Zn @ 6 kg ha^{-1}). The research results indicated that increasing levels of vermicompost and zinc increased the nutrient content in plant and soil as well as productivity of greengram crop. However, the application of zinc affects the phosphorus content in plant as well as soil due to the antagonistic relation between zinc and phosphorus.

***KEYWORDS:** Greengram, Nutrient content, Vermicompost, Yield and Zinc*

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INTRODUCTION

Pulses are important food crops and offer significant nutritional and health advantages due to their high protein and essential amino acid content as well as being a source of complex carbohydrates and several vitamins and minerals. They are recommended for preventing chronic diseases and obesity. Their nitrogen-fixing qualities can improve soil fertility and produce a smaller carbon footprint. In India, total pulses are grown on 25.46 million ha area with a production of 22.40 million tonnes and an average productivity of 814 kg ha^{-1} (DES, 2016). Greengram [*Vigna radiata* (L.)] is one of the important *kharif* pulse crops. It ranks third among all pulses grown in India after chickpea and pigeonpea. It contains 25 per cent protein. Greengram is a rainfed crop predominantly grown in *kharif* in the state of Rajasthan. In Rajasthan, greengram occupy 1.039 lakh ha area and production of 0.491 lakh tones with 394 kg ha^{-1} productivity (DOA, 2016).

The fertility status of soils of semi-arid region of Rajasthan is also poor and low organic carbon status due to high temperature. However, there is a great possibility for increasing the production of greengram by bringing more area under cultivation and by using vermicompost with balanced fertilization and maintaining soil fertility status. The role of organic materials in maintaining and increasing soil fertility is a well established fact to sustain reasonable productivity. The application of vermicompost not only adds plant nutrients (macro and micro) and growth regulators to the soil, but also increases soil water retention, microbial population, mineralization and release of nutrients. Micronutrients are equally important in plant nutrition as the major nutrients; they simply

occur in plants and soils in much smaller concentrations. In many parts of the country, Zn as a plant nutrient now stands third in importance next to nitrogen and phosphorus (Takkar and Randhawa, 1978). Zinc is one of the essential micronutrients and plays an important role in various enzymatic and physiological activities of the plant.

The efficiency of native micronutrients is further improved when these are used in conjunction with organic manures especially when the soils are belonging to arid and semi-arid areas having light texture, low in organic carbon, low moisture retention and microbial activity. Hence, the present experiment was carried out to evaluate the influence of vermicompost and zinc on growth, yield attributes and yield of greengram.

MATERIALS AND METHODS

The field experiment was conducted at College Farm, S.K.N. College of Agriculture, S.K.N. Agriculture University, Jobner,Rajasthan (26.05° N latitude, 75.28° E longitude and 427 m altitude above mean sea level)during *kharif* season of 2016. The soil of experimental field was loamy sand, alkaline in reaction(pH 8.10) having136.60 kg ha^{-1} available N(Alkaline permanganate method, A.O.A.C., 1970), medium in available phosphorus (17.50 kg ha^{-1}, Olsen's method, Jackson, 1973) and medium in available potassium (149.50 kg ha^{-1}, Flame Photometer method, Jackson, 1973) in 0-15 cm soil depth at the start of the experiment.Seed rate of 20 kg ha^{-1} of greengram variety 'SML- 668' was used for experimentation. The experiment was laid out in a randomized block design with three replications. The four vermicompost levels used were VC_0 : control, $VC_{2.5}$: VC @ 2.5 t ha^{-1}, $VC_{5.0}$: VC @ 5.0 t ha^{-1} and $VC_{7.5}$: VC @ 7.5 t ha^{-1} and five zinc levels were Zn_0 : control, Zn_2 : Zn @ 2 kg ha^{-1}, Zn_4 : Zn @ 4 kg ha^{-1} and Zn_6: Zn @ 6 kg ha^{-1}. Vermicompost was incorporated into the soil before sowing of greengram crop as per treatments. The seeds were inoculated with rhizobium @ 20 gm kg^{-1} seed at the time of sowing. The recommended dose of nitrogen (20 kg ha^{-1}) through urea, phosphorus (30 kg ha^{-1}) through DAP, potassium (10 kg ha^{-1}) through MOP and zinc through $ZnSO_4.7H_2O$ were applied as basal as per treatments.

RESULTS AND DISCUSSIONS

Effect of Vermicompost

The application of vermicompost at increasing rates significantly increased N, P and K content and uptake in grain and straw of greengram crop (Table 1 and 2) as well as the organic carbon, available N, P, K and Zn content of soil. The application of vermicompost also enhanced the grain and straw yield of greengram (Table 3). The significant increase in grain and straw yield under the influence of vermicompost was largely a function of improved nutrient content and uptake in plant and soil. The positive influence of vermicompost was due to an adequate supply of nutrients in the root zone and plant system. The significant increase in nutrient content of the soil may be ascribed to the beneficial role of vermicompost in mineralization of native as well as its own nutrient content by creating favorable conditions for microbial as well as chemical activities which enhanced the available nutrient pool of the soil. The interrelationship between nutrient content,uptake and its grain and straw yields had also been observed by Bakthavathsalam and Deivanayaki (2007), Sutaria *et al.* (2010), Meena *et al.* (2014), Jat *et al.* (2015) and Sharma (2016).

Effect of Zinc

The application of Zn significantly increased the nitrogen, potassium and zinc content and uptake in grain and straw of greengram as well as the available nitrogen, potassium and zinc content in soil after harvest of crop (Table 1, 2 &

3). The significant positive response of greengram to zinc application on nitrogen, potassium and zinc content could be attributed to an enhanced availability of zinc in the soil at which the optimum requirement of the crop is fulfilled. On the other hand application of zinc significantly decreased the phosphorus content in grain and straw of greengram and the availability of phosphorus (Table 1, 2 & 3) the cause behind this can be ascribed to antagonistic effect of zinc on availability of phosphorus, due to formation of insoluble zinc phosphate at higher concentration of zinc which reduce the availability of phosphorus. The grain and straw yield were also significantly increased by the application of zinc (Table 3). The increase in these nutrients content and uptake ultimately results in the increased yields due to application of zinc were also reported by Sammauria (2007), Singh *et al.* (2009), Tripathi *et al.* (2011) and Jat *et al.* (2015) in different crops.

CONCLUSIONS

On the basis of experimental finding, it is concluded that the combined application of vermicompost @ 5.0 t ha^{-1} and zinc @ 4 kg ha^{-1} along with the suggesed dose of fertilizers can be recommended for greengram crop in the Entisols of Rajasthan.

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Table 1: Effect of VermiCompost and Zinc On nutrient Content in Green Gram

Treatments	Nitrogen Content (%)		Phosphorus Content (%)		Potassium Content (%)		Zinc Content (mg kg^{-1})	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
Vermicompost Levels (t ha^{-1})								
Control (VC_0)	3.282	1.391	0.437	0.162	0.404	0.846	40.38	44.67
2.5 ($VC_{2.5}$)	3.609	1.524	0.452	0.167	0.459	0.911	42.99	47.36
5.0 ($VC_{5.0}$)	3.945	1.645	0.492	0.197	0.520	0.983	46.64	50.94
7.5 ($VC_{7.5}$)	4.005	1.675	0.501	0.199	0.527	0.994	47.57	52.30
S.Em$\pm$	0.026	0.011	0.004	0.001	0.003	0.008	0.40	0.78
CD (P=0.05)	0.075	0.032	0.012	0.003	0.009	0.024	1.16	2.26
Zinc Levels (kg ha^{-1})								
Control (Zn_0)	3.342	1.398	0.480	0.195	0.417	0.851	40.67	44.44
2 (Zn_2)	3.584	1.501	0.475	0.187	0.455	0.901	42.79	47.26
4 (Zn_4)	3.861	1.662	0.468	0.173	0.503	0.984	45.92	50.63
6 (Zn_6)	4.055	1.673	0.460	0.170	0.534	0.999	48.21	52.94
S.Em$\pm$	0.026	0.011	0.004	0.001	0.003	0.008	0.40	0.78
CD (P=0.05)	0.075	0.032	0.012	0.003	0.009	0.024	1.16	2.26

Table 2: Effect of VermiCompost and Zinc on Nutrient Uptake in Green Gram

Treatments	Nitrogen uptake(kg ha^{-1})		Phosphorus uptake(kg ha^{-1})		Potassium uptake(kg ha^{-1})		Zinc uptake (g ha^{-1})	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
Vermicompost Levels (t ha^{-1})								
Control (VC_0)	28.48	27.72	3.76	3.18	3.50	16.84	754.56	1732.67
2.5 ($VC_{2.5}$)	39.76	38.18	4.95	4.13	5.06	22.80	1048.68	2386.13
5.0 ($VC_{5.0}$)	46.99	47.12	5.80	5.55	6.19	28.14	1224.80	2944.75
7.5 ($VC_{7.5}$)	48.53	50.62	5.98	5.83	6.47	29.95	1270.48	3163.93
S.Em$\pm$	1.04	0.89	0.12	0.08	0.13	0.55	27.29	55.84
CD (P=0.05)	3.00	2.58	0.34	0.22	0.39	1.58	78.83	161.29
Zinc levels (kg ha^{-1})								
Control (Zn_0)	29.16	27.61	4.17	3.85	3.66	16.78	762.31	1725.38
2 (Zn_2)	39.77	38.33	5.26	4.77	5.06	22.98	1039.99	2395.39
4 (Zn_4)	45.97	47.82	5.55	4.98	6.02	28.28	1236.06	2988.57
6 (Zn_6)	48.86	49.89	5.57	5.09	6.49	29.69	1260.16	3118.14
S.Em$\pm$	1.04	0.89	0.12	0.08	0.13	0.55	27.29	55.84
CD (P=0.05)	3.00	2.58	0.34	0.22	0.39	1.58	78.83	161.29

Table 3: Effect of VermiCompost and Zincon Soil Properties and Yield of Kharif Green Gram

Treatments	Organic carbon (%)	Available N (kg ha^{-1})	Available P_2O_5 (kg ha^{-1})	Available K_2O (kg ha^{-1})	Available Zn (mg kg^{-1})	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
Vermicompost levels (t ha^{-1})							
Control (VC_0)	0.189	131.27	18.07	155.42	0.439	862.18	1977.72
2.5 ($VC_{2.5}$)	0.204	136.05	18.98	180.98	0.475	1095.26	2487.74
5.0 ($VC_{5.0}$)	0.210	141.20	20.00	195.30	0.503	1182.17	2839.47
7.5 ($VC_{7.5}$)	0.223	145.30	21.64	202.30	0.530	1197.27	2968.34
S.Em$\pm$	0.004	1.33	0.30	4.24	0.003	24.04	46.85
CD (P=0.05)	0.012	3.84	0.88	12.26	0.009	69.43	135.31
Zinc levels (kg ha^{-1})							
Control (Zn_0)	0.197	130.26	21.15	161.98	0.441	868.08	1962.74
2 (Zn_2)	0.208	138.20	20.17	174.58	0.470	1098.03	2524.43
4 (Zn_4)	0.209	139.95	19.21	191.56	0.506	1178.67	2844.19
6 (Zn_6)	0.212	145.40	18.15	205.89	0.530	1192.10	2941.89
S.Em$\pm$	0.004	1.33	0.30	4.24	0.003	24.04	46.85
CD (P=0.05)	NS	3.84	0.88	12.26	0.009	69.43	135.31